PROCEEDINGS
Third Annual RE$EARCH Money Conference
"R&D Investment: Assessing the Return"
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Prepared by Tim Lougheed

"Most people don't understand how R&D spending generates wealth. If we succeed in this conference, you'll be able to excite colleagues, you'll be able to excite politicians, you'll be able to excite your bosses, and you'll even be able to excite your friends about the possibilities for Canada."

— Jeffrey Crelinsten, Publisher, RE$EARCH Money

Keynote Address

"Today's Investment, Tomorrow's Return — A Catalyst for Resurgence"

Sir Terrence Matthews, Chairman and CEO, March Networks Corporation; Chairman, Mitel Networks Corporation

Describing himself as a veteran of the new economy based on technology, Matthews described the last few years as nothing less than an "ugly environment" for that economy. For Canada in particular, 2003 was especially unpleasant, with major social and economic problems that included SARS, mad cow disease, the war in Iraq, and the challenges of a more powerful currency.

By way of putting such problems in perspective, Matthews noted the important role of R&D activities within a company. He recalled founding Mitel for $4,000, and using R&D to offer a key component of communications technology at precisely the time when potential customers in the marketplace were replacing and upgrading their equipment. He argued that R&D is as critical to identifying such opportunities as it is to acting on them.

"If you're in the business, you can identify the winning technologies, whether they're umbrella technologies or detailed little focus items. I can tell you from personal experience, you have to conduct R&D. It doesn't matter who pays for it, whether it's government grants, government loans, someone else giving you a loan, or equity funding; it doesn't matter where the money comes from. I am an out-and-out passionate, enthusiastic person about R&D. No R&D, no future. No R&D, no innovation."

By meeting customer's needs, you get them to share additional information about what they need, and why. Matthews observed that he has been involved in about 100

companies over the last 30 years; despite all that has gone on during the last two years, he has been supporting R&D activities. After selling Mitel some time ago, he recently bought the company back for $250 million, and invested an additional $200 million in R&D. That has positioned his firm to take advantage of a new wave of technological change that is going to occur soon. That change centres around improvements in the fundamental systems behind networking technology that businesses around the world will be seeking to adopt.

"As we speak, 2003 was an awful year for business. How many companies have gone bankrupt, how many companies have laid off, how many technology workers even in this city have no jobs, how many VCs have moved in like vultures? But the truth is, we're moving onto the biggest single opportunity I have ever seen in business, which is the complete retooling of every business on the planet to next generation collaboration and convergence. By the way, I'm not asking you for your comment. I'm telling you that that's the case. I'm telling you because I'm out there on the streets talking to the clients, and feeling damn good about it because I spend money on R&D. I see the window of opportunity. It's beginning to come up, and next year will be a glorious year for those that took the risks. And I'll be one. I just wanted you to know."

Based on previous technological shifts, Matthews outlined the coming changes as being nothing less than startling. Information storage or transmission costs could drop by as much as 100:1, while capacities could expand by the same order of magnitude. In addition, he pointed out that in the wake of the serious contraction that has characterized the technology sector over the past few years, no less than $2.5 trillion has been pulled out of the investment market. That money will undoubtedly make its way back into the market as part of the replacement process.

The implications of such opportunities include social benefits. In parts of Canada with no technology industry, argued Matthews, young people grow up and leave. Yet the same technology that lures them away can also enable them to stay there and thrive. Ironically, because labour costs and space costs in outlying centres are lower than in major urban areas, that technology could allow people in the former to compete far more effectively than those in the latter.

Such advantages go back to R&D, which has the effect of raising education levels. Canada already has a laudable reputation in this regard, but Matthews cautioned that it is the reputation of the United States that affects this country at the most basic level. "More than any other country in the world, we are measured by what goes on in the US, whether it's the tax regime, whether it's technology changes. The US is the world standard and we are right against that border."

Of all the Fortune 1,000 firms, he said, fully half are in the US, and they affect every country on the planet. And behind each of these companies are thousands more that are

associated with them. "For every GM or IBM, there's 1,000-5,000 suppliers, and there's 1,000-5,000 on the selling side." It is this kind of association that drives the return on investment that can be expected from R&D. And although this may consist primarily of private sector activity, it is the government that stands to gain a great deal from it. For every $1,000 invested at the early stage in a successful venture, he calculated, nearly $5,800 ultimately gets returned to the government in the form of tax revenue. Referring specifically to Newbridge, he calculated the government's return on its investment at 600 per cent. Nor is Newbridge alone in this regard, he insisted; many other companies enjoyed such success, along with the same wide-ranging impact on the local economy, and the people taking part in that economy.

The key to getting this process started lies with the investors, particularly the angel investors who are so crucial in the earliest stages of a venture. Matthews therefore suggested that the government led by Paul Martin should introduce a capital gains tax holiday to encourage this kind of investment.

"How can we build an economy for the 21st century if we rely on a concept of risk from the 19th century? We need to get on with it, we need to work with this new government, help them to understand that the early investors are where it's at. Now is a great time to do things to get more availability of labour, availability of facilities. And guess what, within the next few years if we can pull this off, all R&D money will reap the rewards. The economy will reap the rewards."

Session 1

"Measuring Returns to Research in the Private Sector"

Rosalie Ruegg, TIA Consulting Inc.; former Head, Economic Assessment Office, National Institute of Standards and Technology, Washington D.C.

Contrasting the social returns of R&D with the private returns, Ruegg offered a description of the many different methods that can be used to conduct a public sector analysis of those returns, along with some examples of those methods in practice.

Private returns adopt the perspective of an individual firm, she said, while social returns generally represent the state of an entire nation. Social costs and benefits are therefore often difficult to pin down. Costs such as air pollution or water pollution incurred by economic activity are difficult to quantify in their entirety, while benefits such as national innovation capacity are similarly amorphous.

More specifically, though, parties in the public sector often want to assess their return on any investment they might make in R&D. Those investments can take different forms:

— research tax credits, direct support for basic research and high-risk applied research, areas where private companies may not put their resources;
— development of enabling technologies and research infrastructure that provides help in both public and private spheres;
— maintenance of organizations operating around a specific, well defined mission, such as NASA;
— special sponsorship of critical technologies, which have been deemed to be especially valuable for social or economic benefits.

The evaluation of research provides an advantage to any manager, but in the public sector evaluation has become an important part of accountability. This latter characteristic is both a blessing and a curse, Ruegg observed.

“The increasing emphasis in the government on accountability is driving public managers to focus much less on just inputs — how many dollars did they spend, how many workshops did their people go to, how many conferences did they hold — to outputs, to outcomes, and to impacts. On the other hand, there’s a great deal of emphasis today on centralized reporting in the US, and a lot of the government agencies are struggling to capture the richness of what they do and roll it up into a couple of numbers that can be understood by those who look at it – in the US, the Office of Management and Budget.”

Ruegg listed a number of methods for assessing the return on these various forms of public research. Some of the methods are similar to those found in private sector assessments, although those typically concentrate more on expert judgements and economic measures. Public sector organizations are usually after things that are more difficult to capture. By way of illustration she offered three examples.
— bibliometrics, such as data mining in scientific literature;
— economic case studies, using classical economic measures;
— portfolio analysis, taking stock of progress at various points in a project’s development.

Bibliometric analysis can point clearly to the important role played by publicly funded research in commercialization that results in patents. One study showed 74% of the US patents in 1988 cited such research, whether it be at government labs or universities. By 1998, a later study found, that figure had risen to 80%. Ruegg noted that the finding yielded a well-received article in the New York Times, which referred to publicly funded research as a “pillar” of economic development.

Classical economic analysis can yield similar results, albeit not quite so clearly. The Advanced Technology Program, with which Ruegg was formerly involved, applied such measures to seven specific projects on tissue engineering, looking for private returns, public returns, and social returns. Private returns were harder to pin down, as companies wanted individual returns kept secret, but an aggregate measurement showed returns in

excess of 100%. Similarly, the public rate of return was estimated to be 116%. The social returns were more challenging to define, and even changed over time, since some outcomes initially considered to be less beneficial might in fact turn out to be moreso, e.g. a medical technique that makes a previously existent treatment cheaper and more widely available, enhancing the value of that treatment.

Portfolio analysis employs indicator data while a particular initiative is under way, examining indicators such as the number of collaborations formed, jobs created, publications or patents — all in the context of the investment that has been made to that point. This approach has the effect of pressuring participants to show results all along the way, including the creation of knowledge, dissemination of knowledge, and economic growth.

Ruegg offered several key conclusions:
— assessment of returns on public market research tends to be more complicated than private sector research, simply because there are more factors to take into account;
— the assessment of public-private partnerships is even more complicated, because it calls for two competing concepts: the potential displacement of private sector work that might have happened anyway, versus an absolute contribution to R&D;
— the closer you are to market, the easier it is to do these kind of assessments;
— differences in assessment are mirrored by the difficulty that often emerges in finding public support for research, viz. the fact that even proven and accepted public R&D continues to find critics.

With regard to the last point, Ruegg responded to a question about the value of devoting resources to a quantitative evaluation of public sector R&D activities. In the US, she insisted, this effort is crucial to maintaining support.

Session 2

Panel Discussion: “SMEs and R&D”

David Martin, Chairman and Co-CEO, Smart Technologies, Inc.
Doug Pincock, Chairman, AMIRIX Systems Inc.
Jim Roche, President and CEO, Tundra Semiconductor Corporation
Moderator: Margot Montgomery, Director General, Industrial Research Assistance Program

Montgomery began by asking each of the panel members to introduce their particular line of business, and why they see a need to conduct R&D in connection with that business.

Martin described the advent of Smart Technologies with the original development of an electronic white board in the early 1990s. Today the firm employs some 110 people in

R&D, and many of them are working on base technology, rather than high-end refining of a marketable product. He outlined this kind of activity as crucial to maintaining the company's 60 per cent share of the market.

"With 52 patents now applied for, you can believe that we're trying to prevent anyone else from coming behind us in our particular market. If we're going to win, we want to win big. We want to ensure that we are the market leader in the long run."
David Martin, Smart Technologies

Pincock emphasized that while AMIRIX is an SME based in Halifax, it does not market itself as a regional firm but instead one with a multinational presence. The company manufactures software systems that can be embedded directly into specific hardware platforms, finding applications in areas such as defence, aerospace, medicine, and telecommunications. He observed that the company now spends some 10 per cent of its revenue on R&D, which he regards as essential to tackling technical problems with technical outcomes.

Roche outlined Tundra as a larger SME specializing in system interconnects, software and hardware interfaces that occupy a critical place in many information storage and communications systems. When the market for such products began to deteriorate seriously a few years ago, he said the company's response was to increase its R&D levels, as well as looking toward acquisitions that bring highly developed innovations in-house. He echoed Matthews' earlier remarks about such measures keeping the company in touch with the needs of the market.

Montgomery subsequently asked the panel members to describe how they allocate resources for R&D, how they assess the return on that investment, and what the role for government might be in that process. Pincock suggested that it can be difficult to predict the impact of these expenditures until later on, but all three panelists stated that some form of internal assessment was essential to ensuring the value of R&D. In the case of AMIRIX, this sometimes means generating a formal business case, with an eye toward creating useable intellectual property that could mean new revenue for the company later on. Roche outlined a high-level strategy to determine and define the terms of the business opportunity that might be available to the company. This process then turns into more specific discussions about concepts for products, bouncing ideas off customers as well. The business case results are reviewed on a quarterly basis, observing what has happened and what is going to happen, in order to learn if the results are meeting expectations. They also apply metric parameters called performance factors, measures such as customer satisfaction or market share, which provide a numerical perspective on how well the innovation is doing.

Martin referred to striking a balance between high risk, cutting edge projects and more predictable work driven by where people in the company perceived their business to be.

In the case of Smart Technologies, that distinction has often been driven by the important feedback generated from requests for custom design work — what he called "weird and wacky phone calls". Firms ignore such input at their peril, Martin warned, because it reveals important trends and prospects in their business channel, which in turn determine how R&D should be done and who should be doing it.

"We're becoming an imaging company. Four years ago we had zero capability in optics or imaging. Yet 38 of our 110 folks are experts now in that area. So going forward, how do our new ideas fit into our existing talent pool? We do no research and no development unless we understand what the customer need is. "

David Martin, Smart Technologies

When asked about the impact that new technology is having on the technology industry itself, the panel suggested that in spite of major progress in communications and data processing, it takes as much effort as ever to round up business.

"We're still spending just about as much on securing a customer as we did five years ago."

Jim Roche, Tundra Semiconductor

When asked directly by moderator Montgomery about federal support for R&D efforts, Pincock and Roche both suggested that the federal support their companies had occasionally received for R&D projects had been a valuable contribution. Martin noted that his firm was not looking for such help at all anymore, even though Smart Technologies had received IRAP funding early on.

Session 3

Panel Discussion: "Big Business and R&D"

David Brown, Vice President, Business Strategy, Creo Inc.
Frank Dottori, President and CEO, Tembec Inc.
André Marcheterre, President, Merck Frosst Canada
Moderator: Andrew Bjerring, President and CEO, CANARIE Inc.

Bjerring asked the panel members to explain how much their companies were investing in R&D, and why. The representatives of information technology manufacturer Creo and pharmaceutical manufacturer Merck Frosst cited their respective annual R&D expenditures as being 16% and 14 % of revenues, while Dottori said Tembec spends between 3% and 5%. He noted that although his company's figure seems low, it is in fact much higher than the pulp and paper industry average, which is about 0.5%. He added that Tembec's higher investment reflected a belief in the importance of R&D to

innovation and the ability to survive fluctuations in the marketplace. The others concurred on this point.

The panel also considered the fact that large firms can readily make R&D investments in places other than Canada; Bjerring asked panelists to describe the factors contributing to that decision. First and foremost is cost, as determined by such elements as a local tax regime, but the degree of local IP protection or the availability of talent can also be significant.

"It's not about getting money from government, it's about getting good policy in place."
André Marcheterre, President, Merck Frosst Canada

Dottori made the point that the pulp and paper industry annually brings some $42 billion in revenue to Canada but is ignored on the public agenda, since it lacks either the cachet of firms in the high tech sector or the sense of impending doom associated with economic bastions like Maritime fisheries. However advanced pulp and paper facilities might be in terms of technological innovation, they tend to be seen as a "traditional" industry. That said, Dottori nevertheless portrayed the Canadian R&D environment as the best in the world.

Bjerring asked specifically about how each company measured their return on investment for R&D activities. Brown described Creo's approach, which requires project teams to maintain fully costed, five year economic models for their work. By looking at the ultimate value of the investments that are being made, the company determines a "hurdle rate" for success, for example a return twice the amount originally paid into the project. Marcheterre pointed out that Merck Frosst Canada's R&D initiatives are driven by decisions made at a higher level, so a business case for any work done in Canada must be presented to the central adminstration. Dottori explained that such decisions at Tembec were guided by the company's vision of its business, and individuals or groups proposing R&D work are required to link their proposals to this vision, ranking the project using criteria such as "compulsory" or "desirable".

Dottori also forcefully criticized the Canadian tendency to be "afraid of our own shadows" in terms of competing on an international basis. He especially believes that the innovative capacity and sheer economic might of the country's resource industries has been widely underestimated. He insisted that higher profile enterprises in areas such as high tech actually come up as a negative in terms of our balance of trade, which is compensated by the substantial revenue brought in through the natural resources sector.

"We're considered hewers of wood and drawers of water, despite the fact that we've created Canada's wealth for the last 100 years and will do so for the next 50. There's no credit given; it's a mature industry. We buy the high tech. Our company has the most

advanced computer in the world running a paper machine, but people talk about Japan, they talk about other things."

Frank Dottori, Tembec Inc.

Bjerring cast the panel's theme — strategies for keeping large, innovative intensive firms in Canada — in terms of a popular stereotype of the Canadian entrepreneurial "dream", which is that you get large enough and some larger firm elsewhere buys you out for a great deal of money. Brown suggested there was a great deal of truth to this stereotype, and that these international takeovers are often perceived as success, even though they do not necessarily represent the best way of ensuring the sustainable growth of these businesses. More specifically, he suggested that this outcome reinforces a business culture that does not encourage entrepreneurs to take the risks that are necessary for them to become internationally competitive.

"The key issue we have is a cultural one. We don't support risk taking, we don't support growth; we don't really even approve of it very much, as a country. Certainly from a media perspective or a government perspective, anyone who's successful in business is regarded with a little bit of suspicion."

David Brown, Creo Inc.

Brown later added that linkages with publicly supported institutions such as universities were not particularly helpful to his firm. Instead, he regards these institutions as a valuable source of talent, and the government's role in this would be to ensure that the quality of these individuals remains high. His firm participates actively in this goal through co-op programs and other opportunities for nurturing a climate that welcomes innovation and innovative people.

Dottori and Marcheterre both expressed a desire to see the new government under Paul Martin offer a formal recognition of innovation by companies such as theirs. Dottori noted that a new pulp mill employing a process that reduces harmful effluents by 98% is nothing less than revolutionary in his business, but it is possible that within government and in the general population this will be seen as just another pulp mill. Marcheterre emphasized that while a great deal of the investment in R&D concentrates on universities, that investment does not begin having a profound economic impact until it is transferred into a commercial context.

"We need a structure to effect a transfer of technology from the public sector to the private sector. When a researcher gets out with a discovery, he or she is in the street with no money. We need a strategy to fund these discoveries and potential new companies. We also need incubators to take them off the street and into labs and offices."

André Marcheterre, President, Merck Frosst Canada

Brown said that he wanted the government to find a way to celebrate the successes of people who bring new ideas into the marketplace, to make them heroes. "I don't think they're getting anything like this level of recognition. In fact what they get is a level of suspicion that they are people who are trying to pull something off or get away will ill-gotten windfalls. I think this suspicion emanates from government as much as it does from any other source."

Asked if the current government approach to R&D was sufficient, Brown reiterated his support for investment tax credits, which would put money into the hands of the same people who are in turn responsible for putting new ideas into a commercial form. Marcheterre suggested that partnerships between public sector agencies and private firms could yield many benefits, a point that Brown carefully qualified.

"There are reasons for public-private partnerships, but we should be very wary of saying one size fits all, that because a partnership works in biopharma it should work in industrial technology or IT. Let's look at each sector and apply the appropriate tools. Don't try and create a single solution for every industry."
David Brown, Creo Inc.

Luncheon Speech

"Universities and R&D"

Doug Barber, former CEO, Gennum Corporation

Barber began by insisting that the expansion of Canada's R&D activities to meet the federal government's goals for 2010 will not happen unless the people investing in these activities see a substantial economic return on their investment. In the case of private firms, this means sales, for these firms are in the business of making money, not just conducting research.

"No private sector agency is in R&D. Although some do sell R&D, they are in commerce, where they have to create value and receive value for it. There must be value created by the R&D that results in increased commerce, or the investment will not only fail, but it will cease."

He therefore wanted to put the outlook of such firms in an appropriate perspective, and perhaps put the federal R&D initiative in a similarly appropriate perspective. Starting with a database of over 500 companies from Research Infosource Inc., he chose a subset of mid-sized and large firms with significant revenues that are especially active in R&D. During six weeks last summer, he spoke with several dozen CEOs representing this group.

Barber learned that almost none of them were involved in any consultation surrounding the national strategy on R&D. They indicated to him that they see little merit in attending such consultations, which they find to be dominated by the interests of more articulate representatives from academia and government.

The people Barber interviewed also expressed their frustration with what they say is a negative attitude in Canada toward business and commerce. Most of the companies he had identified for his study were trading in more than 30 different countries, with less than 5% of their revenues coming from Canada. Their CEOs told him that the Canadian bias against commercial activities contrasts with what they found in other parts of the world. This is, Barber emphasized, not a matter of investment, but one of culture and leadership.

The centrepiece of Barber's presentation consisted of two slides offering highly distinct visions of how R&D functions. A widely accepted model, which he referred to as "academic", describes the typical Canadian view of a process starting with a pool of good ideas, which leads to breakthroughs and a series of steps to turn technical insights into commercial products, which then somehow find a market.

Barber pointed out some of the key features associated with this R&D paradigm. For one thing, it appears that only a tiny proportion of the ideas being pursued in universities and government laboratories ever move through this process. Secondly, most of the people responsible for applying this model in the public sector have never worked in the private sector. Thirdly, people working in this way have to be highly articulate, because they are constantly making a case for their approach. Fourth, there is increasing pressure from the government on publicly funded groups to ensure that this kind of transfer takes place.

Beyond all of these features, however, Barber argued that an entirely different paradigm describes the way in which a great deal of R&D is pursued. Calling this the Innovation-Commerce Cycle, it starts from the perspective of a paying customer. Harkening back to Terry Matthews' keynote talk, he pointed out that interactions with clients are what set a company's R&D agenda, as well as determining a company's capabilities.

"If you can do anything at all for a customer, you start to learn what you can do. It really opens the world and you get in touch with the needs. And it really is need in the end that drives things."

Barber added that it might be surprising to learn that for most private sector organizations, R&D is too narrow a definition of innovation. Many industries may be doing only a tiny amount of R&D, yet they rely heavily on innovation in a more general sense to survive and thrive. A significant number of the people working in these industries have spent time in public sector organizations, most often universities, so that

they do in fact understand the academic R&D paradigm. For them, the differences between this paradigm and the Innovation-Commerce Cycle are frequently blurred. Usually they are just excited about the technology and want to get on with developing it.

"The academic model doesn't represent what goes on in the private-sector, commercial world. That doesn't mean it's not legitimate, it just means it doesn't represent that. I think sometimes because the academic model is more known to all of us and more broadly embraced, it causes public policy to be less supportive of the enterprises that do it the commerce-centred way."

Barber focused on a major implication of this observation, which is that a primary role of institutions like universities is not exclusively to conduct R&D, but to produce the people who can carry on the innovation process elsewhere.

"I'm positive about the kind of research and development that goes on in the universities. What I'm not positive about is this emphasis on trying to distract them from developing learned people who know how to learn old things, and who can discover new things. That output from universities is extremely important. So the first thing we need to do is get a much better understanding of what successful innovation-intensive enterprises actually do."

Asked about this point afterward, Barber noted that Peter George, who became the sixth President of McMaster University in 1995, has actively moved that institution in this direction, concentrating on a university mission that puts primary emphasis on the graduation of significant numbers of innovative individuals, regardless of discipline.

In this way, Barber regards universities as having a critical role in our society, if the curiosity-driven research conducted in these institutions can better reflect societal needs. And he reminded the audience once again, chief among those needs is the cultivation of a generation of successful innovators. In this respect, universities would be more like private sector firms, becoming sensitive to the interests of clients.

"It's much easier for us to look for ideas generated internally, and to have a more technologically centred enterprise, than to have a customer marketing centred enterprise. The Innovation-Commerce Cycle is simply harder."

Following his presentation, Barber was asked how we could position the Innovation-Commerce Cycle front-and-centre on the Canadian public agenda. He argued that one should simply get on with the process and allow the results to make themselves apparent. Given the high expectations that are often attached to the creation of technology clusters, he observed, trying to design these ambitious outcomes in advance is like planning for happiness.

"We have to talk about the Innovation-Commerce Cycle. We have to think about it. And if we're talking enough about it, we can begin to realize that there are several models of how innovation occurs in a country, and how they link into the commerce of the country. If we start to talk about those with some realism, we will not just generate a cluster, we will generate a nation that thinks differently about its commerce and its economy."

Session 4

Panel Discussion: "Universities and R&D"

Michael Milton, Bell Program Officer, Bell University Labs
John Molloy, President and CEO, PARTEQ Innovations
Mamdouh Shoukri, Vice-President Research and International Affairs, McMaster University
Moderator: Kathryn O'Hara, CTV Chair in Science Broadcast Journalism, Carleton University

Molloy began by pointing out that most university research is curiosity-driven, basic in nature. Intellectual property is very much a by-product of this work, and for that reason it usually emerges in a form that is undeveloped, far from anything like a commercially applicable form. In other words, there is a gap between identifying a research product of value and enticing investors to pay for that value. "Universities have not done a great job of moving products through that gap"

Shoukri agreed, suggesting that a university's primary role in this process is that of creating an interface between the researchers and members of industry. Milton, who develops university-based research programs and projects for Bell Canada Labs, described such an interface in more detail. The process begins by identifying projects that have value for everyone concerned. For Milton, this means viewing curiosity-driven university-based research as something that might be relevant in a commercial sector, such as solving a technical challenge. He often approaches researchers with some of those challenges, asking them if they would or could help. And he is also approached in much the same way by researchers who have concluded that their work has some commercial potential.

Malloy noted a changing outlook on intellectual property at many universities. Some 10 or 15 years ago, he recalled, technology transfer used to be a matter of filing a patent and sending out queries to parties that might be interested in using the patent. Today there is too much competition among universities for this kind of strategy to be effective. Yet most tech transfer remain primarily reactive, lacking the resources to approach researchers, learn where their work is going, and anticipate where breakthroughs might occur.

"Universities can no longer be intellectual property brokers. If you want to move technologies out of universities, you have to have a very dedicated effort to manage the process. It can be done, and it can be done very effectively and it can bring a lot of economic returns."

John Molloy, PARTEQ Innovations

Nevertheless, insisted Milton, "pushing intellectual property out the door" may not be the best way to proceed. He pointed out that there were other ways of handling the interaction between a university and an interested business. Rather than thinking in terms of a specific commodity that the university could supply to business, Milton suggested it would be better to map the common ground between these partners. Malloy countered that simply finding that common ground can be a major undertaking. He maintained that most university research happens without industrial partners, leaving it up to the institution to find such partners after a promising discovery has been made. He agreed that this approach is not effective, but insisted that, with the right people, it is possible to do it right.

"It's not so much the structure or the model, it's the people that you have at play, working at that interface. If you have the resources to bring in the right kinds of people and the right numbers, then you can make a difference. But not many universities have addressed the issue that way."

John Molloy, PARTEQ Innovations

Shoukri observed that he has witnessed a tremendous change in the way people at universities regard their relationship with commercial interests. A decade ago, he recalled, few people asked about the university's IP policy; now this is a common question faculty members put to administrators.

Milton made a distinction between intellectual property and intellectual capital. By building effective partnerships between people on campus and off, joint interests emerge, constituting a shared intellectual capital. This process skirts many of the problems that can be associated with IP, in particular whether it belongs to the researcher, the university or the industrial partner. Shoukri added that the emergence of such common ground will allow the technology transfer process to take place at the same time that the participants are being cultivated as potential future employees or researchers.

Asked afterward what inhibitors there might be to the efficiency of the process of technology transfer in Canadian universities, Milton expressed some discomfort at the implication that universities should somehow be obliged to generate IP. "It would concern me to think that it's a bad thing that researchers focus on the publication of their curiosity-driven research instead of generating licensing agreements."

Shoukri reiterated this point, stating that commercialization efforts should not detract from a university's original mission, which is curiosity-driven research and the training of highly qualified people.

"The most important contribution to economic growth is through training the people who are going to generate wealth, on their own or through the corporations they are going to join."

Mamdouh Shoukri, McMaster University

And Milton suggested that it might not even be necessary for these people to leave the campus at all in order to make an important contribution to Canada.

"I'm just as happy to grow the next series of researchers who will stay right there in the university lab to continue this process as I am to engage people in a commercial setting. Either way, if they're better researchers than they are employees, then that's where they should spend their lives."

Michael Milton, Bell University Labs

Session 5

Panel Discussion: "Government and R&D"

Tom Brzustowski, President, NSERC
Robert Slater, President, Coleman, Bright and Associates
Jeffrey Parker, Executive Director, Technology Partnerships Canada
Moderator: Janet Eastman, Host and Associate Producer, Ottawa Citizen Business Television

Brzustowski began by pointing out that research and development are two very different processes, following different time lines and methods for measuring success. He observed that these differences were evident from the diversity of presentations made during the business panels in the morning. For just that reason, he sees no point to discussing the prospect of having the government "pick winners", since no single program could help all participants in R&D in the same way.

"The issue is not picking winners. The issue is providing government support to Canadian winners to help them compete against other countries' winners, who are getting their governments' support."

Tom Brzustowski, NSERC

Building on these comments, Parker suggested that Technology Partnerships Canada focuses on development. However, he cautions that the government cannot deal explicitly with commercialization, because of World Trade Organization constraints on such

assistance for specific firms. Slater argued that government finds itself increasingly involved in R&D because so many public policy issues call for R&D. Crises such as tainted blood supplies, contaminated drinking water, SARS, or the outbreak of Mad Cow Disease cannot be addressed without some formal analysis, and that analysis must be done in the public sector sphere. The return on these R&D investments can be interpreted in various ways.

"The challenge for me is that this is really not about a financial return on investment. That is probably one of the least important indicators for the government to be providing research and development. What we are looking to do is drive a whole series of broader public goods — things like technology advancements, spin-offs, high quality jobs. The moral of the story is that we don't get judged completely on the basis of how much money we're getting back."

Jeffrey Parker, Technology Partnerships Canada

Slater added that government-sponsored R&D has seen declining levels of support, but noted that this work was still able to offer specific returns. By way of example, he pointed to research into water pollution caused by the pulp and paper industry, which led industry to bring in entirely new measures that were targeted, effective, and financially responsible. He also offered a recent, and highly dramatic instance — Environment Canada's highly accurate predictions about the course of Hurricane Juan, which devastated parts of Nova Scotia last fall. Ironically, this very successful R&D effort did not necessarily limit the scope of the resulting damage, suggesting that the return on this investment had varying dimensions.

"Even with an appropriate warning, it's very difficult to get people prepared to deal with something that they'd never previously experienced. The investment gave you a tremendous forecast, but if you were holding yourself accountable for minimizing damage to the public good, you wouldn't have done nearly as well. You don't just stop with the excellence of science; it has to be connected to a societal understanding so it can respond when it receives the warning."

Robert Slater, Coleman, Bright and Associates

Asked where government investment should be made, Brzustowski distinguished between basic, discovery-oriented research, and investigations designed to tackle specified problems of one sort or another. Consistency and understanding are critical to either type of R&D investment, he insisted, but it is the former that faces an uphill battle in the marketplace, where it can take decades to bring an innovation into commercial fruition.

"Why is commercialization that difficult? First and foremost, it's all technology-push. There's no market-pull. It's somebody who claims 'I've got a great idea' rather than somebody who claims 'I've got a great need'. This is totally different from the finely

tuned system that Doug Barber describes, with many feedback loops involving customers, which can lead to a much higher proportion of successes."

Tom Brzustowski, NSERC

Parker added that investment in specific areas must not only reflect a government's values, but also minimize redundancy and overlap amongst various agencies. He suggested that so many instruments have been introduced to deal with R&D, it is now necessary to ensure that they are all being used to their respective best purposes, rather than perhaps at cross purposes. Slater then reinforced this point by discussing the fragmentation of one of today's foremost research issues, climate change. This complex subject has spawned a wide variety of activities, which raises the question about how to sort out the best ones and allow the inferior ones to be discarded.

"It would be very attractive to contemplate a Darwinian approach, allowing the more successful programs and delivery mechanisms to survive, and those that won't to shrivel."

Robert Slater, Coleman, Bright and Associates

He concluded by envisioning mechanisms for engaging discussion and debate between members of government, scientists, and the public on matters of R&D. Just as important, he insisted, were fora for raising the standards of literacy in these areas.

"Whilst I am full of admiration for RE$EARCH Money in providing fora such as this, actually these are the only fora in this town that provide the venue for these sorts of conversations. And that shouldn't be the case. This should be a hot topic within the ranks of the public service, parliamentarians, etc."

Robert Slater, Coleman, Bright and Associates

Mamdouh Shoukri asked how government laboratories might extend their mandate beyond advice to government policy makers to creating synergetic relationships with universities and industry. Slater responded with a specific example, noting that diverse research efforts are currently underway surrounding various counter-terrorism strategies. Brzustowski suggested that universities could prevent "intellectual rust out" that can occur when scientists in government labs might not be sufficiently challenged.

A lively exchange occurred after David Martin (Smart Technologies) asked for panelists' views about partnerships between universities and foreign firms, where economic benefits of R&D activity could ultimately leave the country. How can we create value here in Canada while playing at a world-class level in a global economy? Brzustowski replied that ownership does matter, noting that support from organizations such as NSERC takes "benefits to Canada" into consideration, although foreign ownership is not necessarily a deal-breaker. "In those areas where the Canadians have been very, very good, even after takeovers by other corporations, I've seen examples where the value-added in Canada and the extent of wealth creation has grown, absorbed from the larger multinational, rather

than given up to it." He urged Canadians to avoid making the “small country excuse”, apologizing for Canadian researchers having to go offshore to find private sector partners for their work.

"When that is being used in a dismissive sense, to shoot down ideas, to shoot down aspirations and whole plans, I find that totally negative. I can then point to a whole bunch of much smaller countries that are way ahead of us by certain measures, that we must compete with and catch up with. We have some superb people here, and our aspirations for excellence and importance should know no bounds."

Tom Brzustowski, NSERC

Parker pointed out that Technology Partnerships Canada’s notion of "benefits to Canada" has evolved over time. Where once it may have been defined strictly in terms of volume of employment or additional manufacturing capacity, now it is seen as a more complex spin-off of benefits, including foreign investments and enhanced R&D activity. “By providing a little bit of government support, we have had major, world-class players in the ICT area, the aerospace and defence area, and the biotechnology area, decide to locate in Canada. And the consequences of that have been very profound. So it’s not a question of where the initial source of capital comes from, it’s that the value of that investment can and should be in Canada."

“What you really need to look at it where the true added value is. It may be that what one hopes to achieve is to maintain the research and development opportunity here in Canada, or to maintain the corporate headquarters and activity here in Canada. We have moved away from simply suggesting that the benefits to Canada be the manufacturing.”

Jeffrey Parker, Technology Partnerships Canada

Session 6

Panel Discussion: “Wrap-up”

Anthony Eyton, President and CEO, Precarn Inc.
Calvin Stiller, Chairman and CEO, Canadian Medical Discoveries Fund; Chair, Ontario Research and Development Challenge Fund
Moderator: David Crane, Economics Editor, Toronto Star

Crane harkened back to the beginning of the day and the talk by Terry Matthews, who emphasized the importance of incorporating the private sector in any R&D effort. More specifically though, Crane suggested that Canada must concentrate on the growing of companies — rather than just establishing them — and growing them to a size where they can be internationally successful. He introduced Eyton and Stiller as members of “fourth pillar” organizations aimed at doing just that.

Stiller suggested that the new federal government should abandon any narrow stereotype that investment in research today yields direct profits tomorrow. He portrayed the real impact of R&D as being much more complex, as well as much more profound. As a magnifier of wealth, this kind of spending is unpredictable; but the activities that surround R&D investment yield direct, significant benefits.

"It's that response to human need, solving human problems, with risk-tolerant capital, with the best young people that you can find, that will result in a rich, healthy community. That's how you produce economic wealth But what is absolutely critical is that innovation, creativity, commercialization, economic activity is seen as a combined activity that has been proven time and time again to occur where you have centres of excellence and risk-tolerant capital."

Calvin Stiller, Canadian Medical Discoveries Fund

Eyton referred to an article by Peter Nicholson in the Fall 2003 issue of *International Productivity Monitor* (available on-line at www.csls.ca) which offers an essentially positive picture of our economic growth and the future of our quality of life. Nevertheless, specific challenges remain, such as the predicted decline of our working age population after 2018. Such challenges call for investments in physical capital, upgrading the skills of our remaining workforce, and revising management practices, all with an eye on innovation.

"Our policy challenges are to create the optimal environment for investment so that the private sector is motivated to invest more in capital machinery. An equally important challenge for us is to find ways and means of improving our overall R&D performance, not only in terms of creating new technologies but finding better ways of diffusing best practices and technologies."

Anthony Eyton, Precarn Inc.

Eyton noted that the framework policies, taxation policies, and regulatory policies we draft must at least be competitive with those in the United States, which continue to serve as a benchmark. By way of example, he recalled Brzustowski's suggestion that government must put in place structures and policies built on adequate support for SMEs, universities, government labs and others engaged in R&D.

Brzustowski's disdain for "picking winners" also entered the discussion. Stiller insisted that the marketplace should be ultimate arbiter of "winners". He specifically rejected the notion that government somehow wields a single answer to economic and social success.

"The fact of the matter is that if you look south of the border, and indeed if you just look in this city [Ottawa], economic growth has come about because of private sector investment — bold, risk tolerant, business leadership."

Calvin Stiller, Canadian Medical Discoveries Fund

Eyton agreed, citing Barber's position on the artificial nature of creating research clusters by government fiat. Clusters grow up because they make sense, he said, and defining them arbitrarily in "new sectors" runs the risks of casting aside support for "old sectors" such as resource industries which, as Dottori insisted in the morning, continue to contribute a great deal to Canada.
At the same time, Eyton expressed his support for technology roadmaps of the sort that have been drafted by Industry Canada, setting out priorities for stakeholders in various R&D sectors. Stiller agreed with the concept, but insisted that such roadmaps need not emerge exclusively from government. Eyton acknowledged the point, but argued that even if such material is prepared privately, government should have a hand in the process. Crane furthered this debate by asking for opinions on the status of the fuel cell industry as an example of critical technology requiring special attention. Eyton endorsed this position, and was immediately set upon by Stiller, who described this conclusion as nothing less than picking a winner.

When asked about the value of a sectoral focus when considering issues of R&D, Stiller echoed the argument that no single policy will work in every industry. The biotechnology sector, for instance, derives little benefits from systems set up to entice venture capital investment in the information technology field.

"We tend to deal with this commercialization as if it were a generic formula, and it is not. It would be wonderful if we had overarching programs that just picked our Wayne Gretskys and gave them whatever they needed. But the fact is that governments with different views come on at different times in the investment cycle who want to achieve different purposes. We happen to have a government right now that is absolutely fixed that their tax credit approach is the foundational approach for getting risk capital into companies for commercialization. And frankly, it doesn't work very well. What would work much better is the framework that is applied in the resource sector, which is flow through."

Calvin Stiller, Canadian Medical Discoveries Fund

Stiller added that large pools of risk-tolerant capital are essential to laying the foundation for prosperity based on R&D. In the absence of such free-floating funds, he warned, the government's efforts to foster R&D activities may simply build a "house that isn't full of anything".

"We have got a lack of coordination, a lack of flexibility between our intellectual capacity and power and creativity and the risk capital to fund that. If we don't create a climate for taking risks and investing in the knowledge based economy, and do it pretty quickly, we will lose the opportunity that has been created over the last decade and a half."

Calvin Stiller, Canadian Medical Discoveries Fund